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Impact of interactive technologies on stimulating learning experiences in a museum

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ABSTRACT

This research proposes a model to assess visitors' learning and engagement with interactive technologies. We test this model with a field study conducted at a French museum where 174 surveys were returned. The results indicate that IT dimensions, namely ease-of-use and interactivity, influence emotional processes (authenticity and cognitive engagement), which in turn influence learning. Our findings show that when users perceive the interaction with technology as being intuitive and interactive, they experience higher levels of cognitive engagement. We also provide recommendations to professionals of the edutainment sector to use interactive technologies to engage their audiences, thereby ensuring positive learning experiences.

1. Introduction

Information technologies (IT) have contributed to changing and enhancing the modes of human learning. Consequently, individuals relying on IT for their education tend to experience a higher level of cognition [3,104]. For instance, Alavi [1] showed that students using group decision support systems had higher interest, developed more skills, and reported a higher overall evaluation of their course. When supporting a learner-centered active learning environment, IT can also encourage critical thinking and can facilitate the understanding of educational materials [2].

To the contrary, other studies indicate that technology-mediated learning (TML), such as web-based coursework, is not necessarily more efficient than traditional teaching [17,79]. In fact, several conditions need to be met for a successful learning experience to occur. For instance, types of knowledge (declarative vs. conceptual) explain why virtual interaction may result in effective learning in certain situations but not in others [17]. Similarly, IT types or IT dimensions differentially influence the learning process [45,57]. Although computer-assisted learning produces factual and procedural learning, virtual environments promote conceptual learning [57]. Self-regulated learning strategies can also influence e-learning outcomes [97].

Alavi and Leidner [4] advance psychological processes as a key determinant of learning outcomes and called for more research on this factor. As a matter of fact, research in education indicates that learning results from psychological processes such as enjoyment [58,59], authenticity [46,51,72], and more generally, emotions [10,36]. Wan et al. [99] also confirmed the importance of analyzing psychological processes in TML research. Cahill and McGaugh [16] showed that emotional arousal (linked to emotional events or experiences) activates hormonal and brain systems that regulate long-term memory, the latter being a fundamental step in learning. In a more recent study on music learning experiences, researchers found that emotions such as affinity or liking help sustain active and continuous learning, especially for young learners [93]. Similarly, Wan et al. [99] showed that psychological processes can lead to learning effectiveness and satisfaction. A study conducted with classroom students also highlights the effects of positive and negative emotions on strategies for learning. One key finding is that "positive emotions are related positively to metacognitive strategies, elaboration, organization, and critical thinking" [77,p. 99].

Although emotions and hedonic systems in general have gained more prominence in information systems (IS) research in recent years, little attention has been paid to their potential role in the TML environment [4,11,12,98]. Consequently, this research aims at analyzing the factors that influence learning, more precisely, the role of psychological processes and IT dimensions.

Another limitation that can be noted in the literature on TML is that research tends to focus on classroom or workplace contexts [e.g.,3,6,17,79,91,101], thus neglecting other organizational environments [45]. Although e-learning has become an important

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vehicle both for college education and for professional training, other environments also offer interesting avenues for a learning experience as exemplified by the quotation below.

In fact, all people today — youth and adults — spend the majority of their lives learning outside the walls of formal classrooms: in out-of-school programs, workplaces, internships, and other informal learning experiences such as those offered by libraries and museums [56,p. 4].

Why do museums qualify as learning environments? As a matter of fact, learning represents one of the fundamental missions of a museum [54]. In 2014, the Institute of Museum and Library Services [55], the primary source of federal support for American museums and libraries, explained that 52.7% of its grants to museums were dedicated to learning experiences, compared with 33.1% for collection stewardship and 14.2% for community anchors [55]. This stresses the important role of museums in learning and skill development. Besides this, many museums rely on IT to communicate with their public as technologies positively contribute to visitors' experiences [9,26,47,59,74].

Despite a growing number of studies that highlight the potential of IT for visitors' experiences, research is still scarce on the specific issue of TML in museums. Therefore, it makes sense to determine the role of IT in how visitors learn. This issue is even more important as people who engage in cultural activities try to escape personal monotony and, instead, look for authentic experiences [64,65]. Visitors' search for authenticity takes different forms. They may want to see genuine things [15] or be reluctant to interact with virtual copies of artifacts or with any other reproduction [7]. Consequently, it is not evident that IT contributes both to higher learning and to a deeper sense of authenticity in the museum context.

Considering these gaps in the literature, the research questions that guide this study are the following:

- How do TML environments affect visitors' psychological processes and learning outcomes in museums? More precisely, what is the influence of technology features – ease of use and interactivity – and emotions (i.e., cognitive engagement and authenticity) on learning outcomes?

The current research aims at measuring both visitors' affective (i.e., entertaining and authentic) and cognitive (i.e., educational) reactions when they interact with technology. As studying human interaction with technologies is at the heart of human–computer interaction (HCI), the questions addressed by this research should be of interest to HCI researchers as well as to researchers who examine TML issues, education, or affective and emotional reactions. Relying on Alavi and Leidner's framework [4] of TML, we hope to contribute to IS research in three different ways. First, this research extends the generalizability of the results found in the TML literature to a new environment. The specific context of museums can produce new and original findings. Second, this research examines the psychological processes that affect learning and introduces an underinvestigated variable, namely perceived authenticity. Third, we also try to assess the role played by IT features by comparing user reactions to two different technologies. This paper provides insights for practitioners as well. In fact, we provide empirical validation on IT effects in enhancing learning and enjoyment, which are two fundamental missions of museums.

This research is organized as follows. First, we consider how the literature has dealt with TML, and we present the recent developments toward a better understanding of its underlying psychological processes. Second, we introduce our research model and its set of hypotheses. Third, we describe the methodology that was implemented to collect data. Fourth, we perform data analysis and report the results. Fifth, we discuss our findings, while the last section concludes with limitations and potential contributions.

2. TML: toward a better understanding of the psychological processes

2.1. IT dimensions and learning

Learning implies "changes in an individual's mental models or knowledge representations" [6,p. 405]. To measure these changes in mental models or knowledge representations, it is necessary to assess learning outcomes. According to Gagne (1977, cited in [4,p. 6]), "learning outcomes can be intellectual skills, motor skills, verbal information, cognitive strategy and attitude." As learning increasingly occur through technologies, we will focus on TML defined as:

an environment in which the learner's interactions with learning materials (readings, assignments, exercises, etc.), peers, and/or instructors are mediated through advanced information technologies [4,p. 2].

Although TML research has mainly analyzed web-based courses [17,79] and group decision support systems [3,6][e.g.,3,6], the technologies that are utilized in this mediation are very diverse. Indeed, technologies can range from a simple instructor console to groupware or virtual reality systems [57]. So, what should be the technical characteristics of a good IT-mediated learning environment?

To address this question, we can turn to results found in previous research, which are quite diverse and mixed in their findings. Webster and Hackley [101] found that reliability, technology quality, and perceived medium richness are significant predictors of attitudes toward distance learning but that perceived medium richness is the only factor influencing individuals' involvement and participation. Media variety was tested in subsequent research, but Marks et al. [66] did not find significant results for the following IT features: audio, video, and PowerPoint use. Marks et al. [66] do not think, however, that their results should be generalized, in that their subjects were making little use of these features. In another study, Arbaugh and Duray [8] also report nonsignificant results on the role of IT characteristics. They tested the role of two classic variables of the technology acceptance model (TAM), namely ease of use and usefulness, but they were unable to verify any relationships with learning.

These fragmented results might be explained by the fact that some researchers addressed IT at the feature level, looking at some functionalities such as the presence of video, audio, and brainstorming, [45] while other studies focused on the system level. Instead, Gupta and Bostrom [45] argue that it is "the structural dimension that the technology provides, which influence[s] learning effectiveness" (p. 695). Depending on the system under study, these structural dimensions can vary. For instance, if the research deals with communication systems, then interactivity and richness may be salient dimensions; if it is an information processing system, authenticity and feedback may be more appropriate [45].

Furthermore, Alavi and Leidner [4] in their research commentary suggest that future research should focus on the relationship between IT dimensions and learning processes to show how technology influences users' internal processes (see Fig. 1). Despite this decade-old call for research, to our knowledge, very few studies have examined this relationship. One was Benbunan-Fich and Hiltz [12] wherein they proposed a model in which technology characteristics influence learning outcomes through the mediation of psychological processes, such as motivation and participation. These IT characteristics include access, functionality, usability, and reliability. But Benbunan-Fich and Hiltz [12] did not test specifically the impact of each of these factors on psychological processes. For this reason, the current research will more fully

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